Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 16 (1): 63–66
https://doi.org/10.15560/16.1.63

PENSOFT

First report of *Helicina chionea* Pilsbry, 1949 from Brazil (Gastropoda, Helicinidae) and new records of *Helicina* spp. from Acre

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Abstract
The present study stems from initial efforts in surveying the terrestrial gastropod fauna of Acre state, an undersampled Amazonian region in northwestern Brazil. Herein, we report the first record of the operculate snail *Helicina chionea* Pilsbry, 1949 in Brazil, alongside the first records of two other helicinids from Acre: *H. juruana* Ihering, 1905 and *H. laterculus* F.C. Baker, 1914. With the present new record, there is a total of 38 helicinid species reported from Brazil.

Keywords
Amazon rainforest, *Helicina juruana*, *Helicina laterculus*, Helicinoidea, Neritimorpha.

Academic editor: Leonardo Santos de Souza | Received 5 November 2019 | Accepted 9 January 2020 | Published 17 January 2020

Citation: Salvador RB, de Lima MS, Lima WC, Simone LRL, Guilherme E (2020) First report of *Helicina chionea* Pilsbry, 1949 from Brazil (Gastropoda, Helicinidae) and new records of *Helicina* spp. from Acre. Check List 16 (1): 63–66. https://doi.org/10.15560/16.1.63

Introduction

The Helicinidae are small operculate land snails belonging to the Neritimorpha clade. They are distributed throughout the tropical and subtropical regions of the Americas, Australasia, and the Pacific Islands, and current estimates put the family's diversity roughly around 1,000 species (Richling 2014). Brazil has a reasonable number of helicinids, with 37 species listed that comprise roughly 5% of the country's land snail diversity (Salvador 2019). Nearly all Brazilian species are presently classified in the genus *Helicina* Lamarck, 1799 (Simone 2006).

Circa 45% of helicinid species in Brazil are reported from regions of Atlantic Forest, with only approximately 20% of the species recorded from the Amazonian region (Simone 2006; Birckolz et al. 2016; Salvador et al. 2018a, 2018b; Silva et al. 2019). Given the known biodiversity of the Amazon rainforest, a higher diversity of these snails could be expected in that region, especially given the number of species listed from neighboring countries (Richling 2014). However, the North Region of Brazil, encompassing the Amazon, remains largely understudied in comparison with eastern and southeastern areas (Salvador 2019).

Acre is a Brazilian state located in the westernmost part of the country and bordered by Peru to the west and Bolivia to the south. The state was originally entirely covered by the Amazon rainforest, but there are surprisingly few land snail records reported from there: only two species have been specifically reported from Acre (Simone 2006; Salvador 2019). As argued by Salvador (2019), since most of the studies in the region were

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the efforts of foreign naturalists dating back to the 19th century, several records could be "lost" in the literature indicated as general entries for the Amazon, Peru, or Bolivia. The reason for that is as follows: the region was conquered by the Spanish and belonged first to Peru, then to Bolivia, and finally became part of Brazil after the Acre War (1899–1903) and the Treaty of Petrópolis in 1903 (Tocantins 2001; Souza 2013).

In any event, no focused collection effort was undertaken in Acre state and published until the present; thus, the region remains vastly undersampled. A budding research project led by the senior author (E.G.) aims to rectify this situation. Early exploratory collection efforts have resulted in new records, which we report herein, focusing on the family Helicinidae. Firstly, *Helicina chionea* Pilsbry, 1949, known from Peru, is recorded from Brazil for the first time and herein added to the country's land snail species list. Furthermore, the presence of two other Amazonian *Helicina* spp. are herein confirmed for Acre, namely *H. juruana* Ihering, 1905 and *H. laterculus* F.C. Baker, 1914.

Methods

Specimens were collected in the Reserva Florestal Humaitá ("Humaitá Forest Reserve") in Porto Acre municipality (Acre state, Brazil; Fig. 1) during ongoing ecological and biodiversity studies in the region. This 2,000 ha reserve represents a fragment of the Amazon rainforest belonging to the Brazilian National Institute of Colonization and Agrarian Reform (INCRA, Brazil) and administered by Universidade Federal do Acre (UFAC, Rio Branco, Brazil), located close to the state's capital. It consists mainly of more open rainforest, with palm trees and bamboo in the understory (Pinheiro et al. 2015).

All specimens were deposited in the malacological collection of the UFAC; the prefix 'IA' used in one case (see below) indicates lots from the old (joint zoology/paleontology) collection. Species identification was conducted based on the original descriptions of the species, other specialized literature (e.g., Simone 2006), and images of the type specimens available in the literature and online collection databases.

The following abbreviations are used herein. Institutions: ANSP, Academy of Natural Sciences of Drexel University (Philadelphia, USA); MZSP, Museu de Zoologia da Universidade de São Paulo; RMNH, Naturalis Biodiversity Center (Leiden, The Netherlands); UFAC, Universidade Federal do Acre (Rio Branco, Brazil). Shell dimensions: H, shell height (parallel to coiling axis); D, greatest shell width (perpendicular to H); W, number of whorls.

Results

New records. *Helicina chionea* Pilsbry, 1949: Brazil: Acre: Reserva Florestal Humaitá (09°45′09″S, 067°38′23″W), coll. L. Freitas, 14/xii/2018, 1 specimen, UFAC 1032. ***Helicina juruana* Ihering, 1905**: Brazil: Acre: Reserva Florestal Humaitá (no coordinates recorded), coll. M.S. Lima, 12/i/2017, 2 specimens, UFAC IA 717. ***Helicina laterculus* F.C. Baker, 1914:** Brazil: Acre: Reserva Florestal Humaitá (09°45′40″S, 067°38′33″W), coll. M.S. Lima, 07/ix/2018, 1 specimen, UFAC 989.

Identification. The specimens could be successfully identified to species level based on conchological fea-

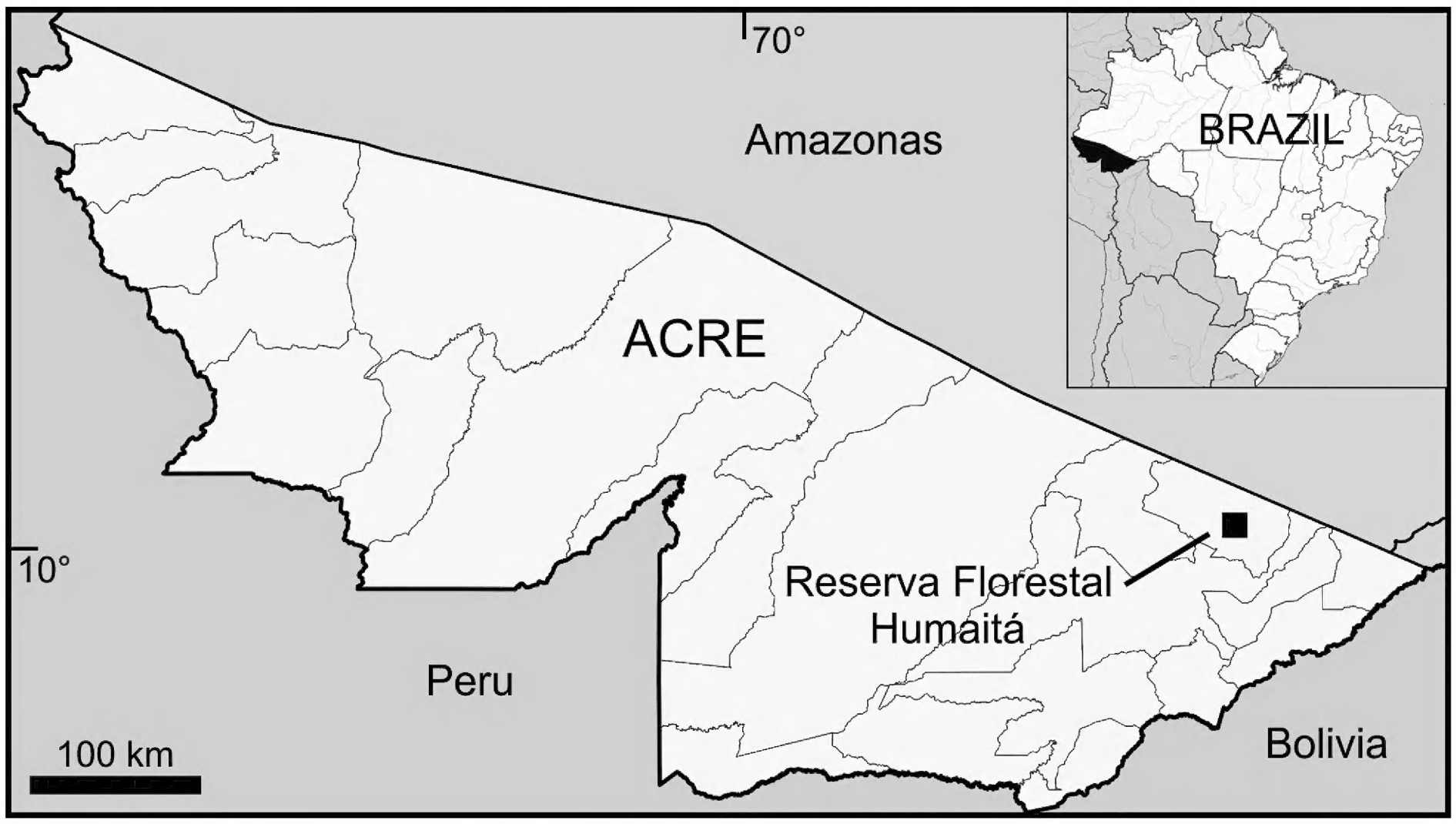

Figure 1. Map of Acre state showing the collection locality, Reserva Florestal Humaitá.

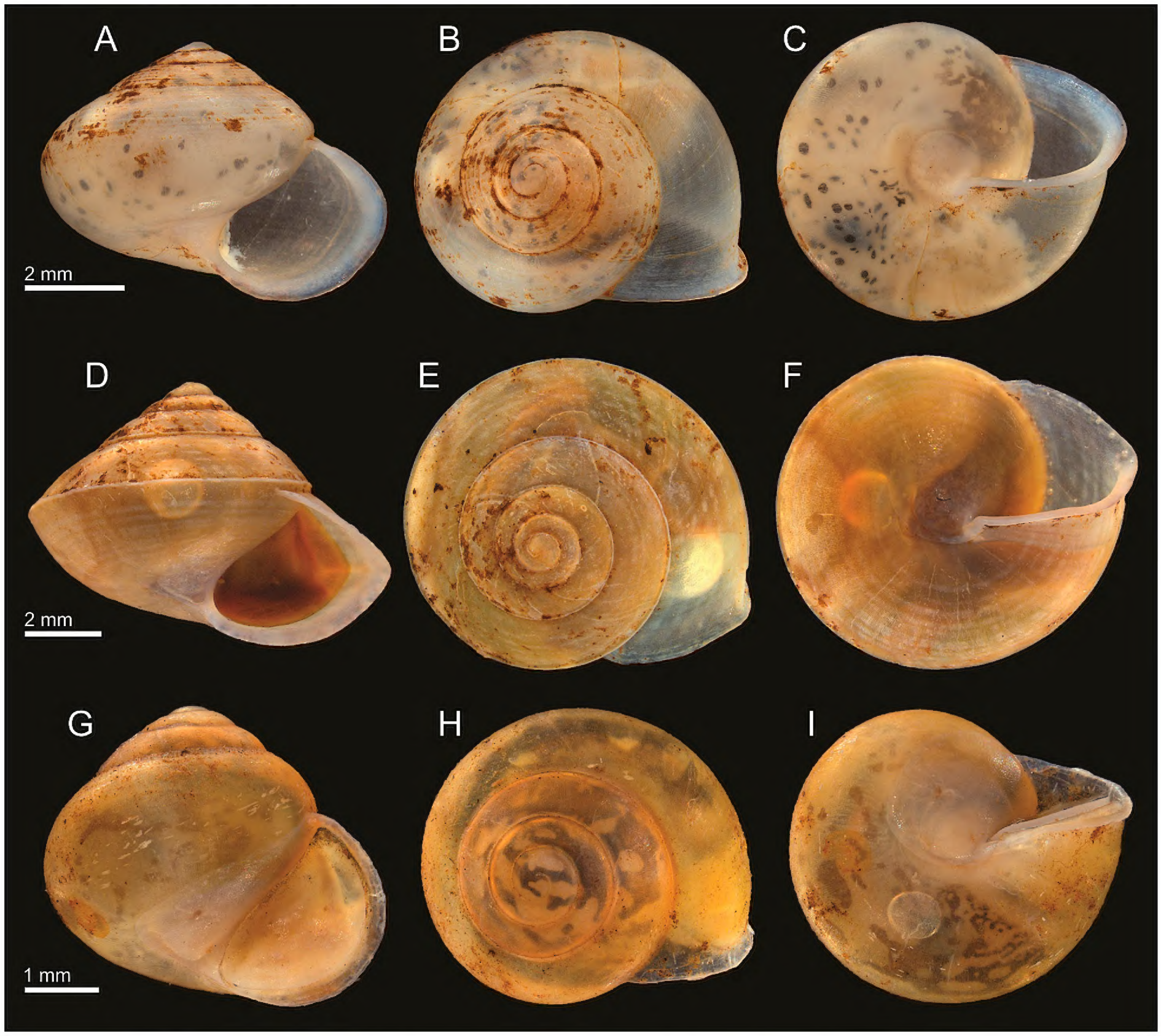

Figure 2. Shells of *Helicina* spp. collected in the Reserva Florestal Humaitá. **A–C.** *Helicina chionea*, UFAC 1032 (H = 5.6 mm, D = 7.4 mm, W = 4¼). **D–F.** *Helicina juruana*, UFAC IA 717 (H =7.3 mm, D = 9.9 mm, W = 4½). **G–I.** *Helicina laterculus*, UFAC 989 (H = 4.2 mm, D = 4.7 mm, W = 4).

tures. The diagnostic characters allowing identification are as follows.

Helicina chionea (holotype ANSP 180005, paratype ANSP 358667) can be mainly identified by its whitish and somewhat translucent shell, with inconspicuous white spiral streaks (Fig. 2A–C; Pilsbry 1949: 101). The following additional features are also in line with the species description and topotypes (e.g., RMNH. MOL.153181): the conical raised spire; the weak angulation on body whorl; and the teleoconch sculpture consisting of fine spiral striae on the adapical portion of the shell. Similar species include *Helicina rotundata* A. Wagner, 1910 and *Helicina schereri* F.C. Baker, 1913, both with disjunct distribution (eastern Brazil), which can be diagnosed by their taller spires, more angulated aperture (for *H. rotundata*), and brownish/yellowish coloration (for *H. schereri*) (Simone 2006; Salvador et al. 2015, 2018a; Silva et al. 2019). *Helicina chionea* was originally described from "Mejorada, near Huancayo" (Pilsbry 1949), in the Peruvian highlands (eastern Andes, ~2600 m a.s.l.), circa 850 km west-southwest of Porto Acre (~150 m a.s.l.).

Helicina juruana (syntypes MZSP 1370) can be readily identified by the pronounced keel on the body whorl and angular aperture, alongside a brownish coloration (Fig. 2D–F; Ihering 1905: 458). A similar species is *Helicina carinata* d'Orbigny, 1835, widely distributed in South America, but diagnosable by usually a more flattened shell and the more convex profile of the whorls (Simone 2006). *Helicina juruana* was originally described from the Juruá River, in Amazonas state, circa 400 km north-northwest of Porto Acre.

Helicina laterculus (lectotype ANSP 109339, paralectotype ANSP 358656) is diagnosable by its small round and smooth shell, reddish-brown translucent color, and semicircular aperture (Fig. 2G–I; Baker 1914: 626). Similar species are *Helicina siolii* Haas, 1949 from Pará state, diagnosable by its shorter spire and wider and less round shell profile, and *Helicina paraensis* Pfeiffer, 1859, also from Pará and diagnosable by its taller spire

and more angulated body whorl (Simone 2006). *Helicina laterculus* was described from Pará state, without any specific locality being given. Pará state is located at least 1,200 km to the east of Acre; it extends further to the north as far as the Atlantic Ocean, and is the second largest state in Brazil.

Discussion

Three helicinid species (*Helicina chionea*, *H. juruana*, and *H. laterculus*) are here recorded for the first time from Acre state. Until now, these species were known only from their type localities (e.g., Haas 1955; Simone 2006), so the present records greatly extend their known distribution within the Amazon biome. Furthermore, the record of *H. chionea* is the first for Brazil, thus adding this species to the country's list of native terrestrial gastropods. With this new record, there is now a total of 38 helicinids reported from Brazil (Simone 2006; Salvador et al. 2018b; Salvador 2019). All three species are, as of present knowledge, restricted to areas south of the Amazon River, but the large tributaries of the Amazon River apparently do not play a strong role in their distribution. This hypothesis would make an interesting topic for further studies with helicinids and other Amazonian gastropods, whose biogeographic history and patterns remain unclear.

Our new findings derive from early exploratory collection efforts undertaken in the region. We are now planning thorough surveys for the near future, so more novelties in other terrestrial gastropod groups might be expected. Furthermore, and running the risk of sounding like a broken record, it is important to reiterate that we need new collection efforts in understudied and undersampled areas such as Acre (see also Salvador 2019). In a similar case, another helicinid species, *Helicina fulva* d'Orbigny, 1835, was recently added to the Brazilian land snail checklist, found in Corumbá, a city in western Brazil close to the border with Bolivia (Salvador et al. 2018b). Given the present state of neglect of the Brazilian government towards the Amazon rainforest (e.g., Nature Editorial 2019) and science in general (e.g., Andrade 2019; Angelo 2019), finding and reporting/describing this fauna has just become more urgent.

Acknowledgements

We are very grateful to UFAC for logistical support; to Vanessa L. de Souza and Lucas Freitas for support and companionship during fieldwork; to Simone Lira (MZSP) for the assistance with collection management; to Jean-Claude Stahl (NMNZ) for the photographs used in Figure 2; and to Bram Breure and Maria G. Cuezzo for the comments and suggestions to improve the manuscript. MSL and WCL received funding from the Scientific Initiation Scholarship Program (PIBIC) of Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil). Specimens were collected under ICMBio/SISBIO authorization no. 10560-1 (in name of LRLS).

Authors' Contributions

MSL and WCL collected the specimens; EG coordinated the fieldwork; RBS and LRLS led the taxonomic study and writing of the manuscript.

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